MAY 10 1921

PUBLIC WORKS

CITY COUNTY STATE

President Harding *Urges* Road Maintenance. *He Says:*

"I KNOW of nothing more shocking than the millions of public funds wasted in improved highways, wasted because there is no policy of maintenance. The neglect is not universal, but it is very near it. There is nothing the Congress can do more effectively to end this shocking waste than condition all Federal Aid on provisions for maintenance. Highways, no matter how generous the outlay for construction, cannot be maintained without patrol and constant repairs."

EXTRACT FROM FIRST MESSAGE TO CONGRESS WASHINGTON, D. C., APRIL 12, 1921

Tarvia
For Road Construction Maintenance and Repair

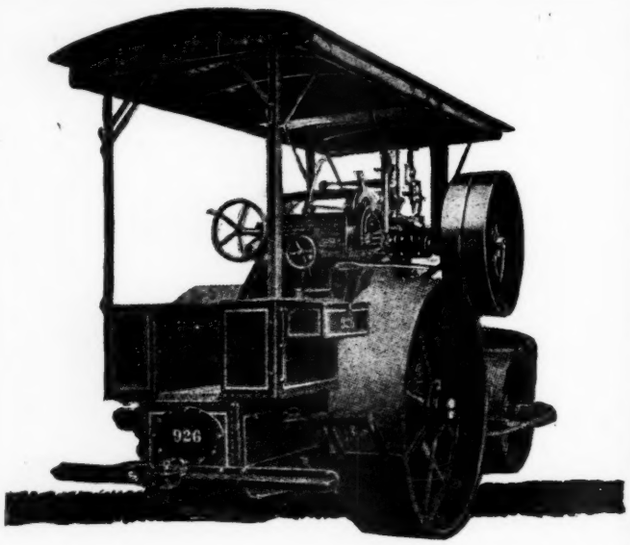
Road patrol maintenance crew patching improved road with "Tarvia-KP"

New York, Chicago, Philadelphia, Boston, Detroit, New Orleans, Birmingham, Kansas City, Salt Lake City, Seattle, Peoria, Atlanta, Johnstown, Lebanon, Youngstown, Toledo, Elizabeth, Buffalo, Baltimore, Omaha

The Barrett Company

St. Louis, Cleveland, Cincinnati, Pittsburgh, Minneapolis, Dallas, Nashville, Syracuse, Duluth, Milwaukee, Bangor, Washington, Columbus, Richmond, Latrobe, Bethlehem, Jacksonville, Houston, Denver

THE BARRETT COMPANY, Limited: Montreal, Toronto, Winnipeg, Vancouver, St. John, N. B., Halifax, N. S.



The Monarch Steam Road Roller

The Monarch Steam Road Roller with extension shaft and pulley for driving a rock crusher. You will never secure complete Road Roller satisfaction until you have used a Monarch. Made in 10 and 12 ton sizes.

Everything for the Road Maker

Road Graders of all sizes from 750 to 7,000 pounds in weight.

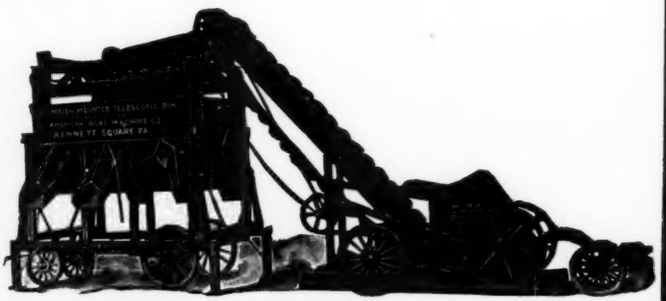
Wheel Scrapers and Drag Scrapers in all sizes.

Rock Crushers with capacities ranging from 50 to 1,000 tons per day.

Tandem Rollers and Macadam Rollers from 5 to 12 tons in size.

Heating Kettles in sizes from 25 to 500 gallons.

Oiling Machines, drawn by horse power, or mounted on auto trucks.



The Champion Steel Rock Crusher

The Champion Steel Rock Crusher, Mounted, with Elevator, Screen and Portable Stone Bin. Easy to set up, to take down or to move. We design, build and install complete Rock Crushing plants of any desired capacity. Our Crushing Machinery is reliable, dependable and is low in upkeep cost. We are specialists in Road Building Equipment for contractors. Our goods are made right, sold right and we furnish the right kind of service.

Corrugated Metal Culvert Pipe

Corrugated Metal Culvert Pipe. Furnished in any length Culvert desired. Guaranteed to last at least twenty-five years under ground. We also furnish concrete and cast iron pipe. Our pipe will meet specifications. All sizes carried in stock.

Our new catalogue "Everything for the Road Maker" will interest you. A copy is yours for the asking.

THE GOOD ROADS MACHINERY CO.

Bulletin Building

Philadelphia, Pa.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879

Vol. 50 MAY 7, 1921 No. 19

Large Reinforced Concrete Covered Reservoir

Vertical walls on limestone ledge as a bottom, with reinforced concrete slab roof, to be used for tennis courts. Walls poured continuously and slip forms used. Column forms used repeatedly.

RESERVOIR WITH ROOF PARTLY PLACED
At right, tent for covering new concrete in freezing weather.

A two-million-gallon concrete reservoir has recently been completed at Arkansas City, Kan., which embodies some interesting features of design and methods of construction.

The water supply of that city is obtained from wells equipped with motor-driven, deep-well type, vertical centrifugal pumps, located approximately 1¼ miles from the high-service pumping station, and is pumped through a twenty-inch wood-stave pipe line to the reservoir located near the main pumping station. The reservoir provides a reserve storage for use in case of interruption of power service or other emergency demands, and which allows the well pumps to operate at uniform steady rates.

The site decided upon as most available for the reservoir location was a low tract of ground that had been of a swampy nature and had been partially filled in with old refuse, brick, tin cans, street sweepings and rubbish. Test borings were made and the results indicated approximately an average of eight feet of old fill and original loam and two feet of water-bearing sand overlying a solid limestone stratum, requiring six feet of tight sheeting to hold the lower banks. The ground water level was approximately four feet above the rock surface. The rock surface was fairly smooth and level, having a grade or dip of less than 8/10 of a per cent. Several faults or cracks, from ¼ inch to 1 inch wide, averaging about twenty feet apart and running at right angles to each other, were cleaned out and grouted full with a 1:2 cement mortar, and after chipping off some of the uneven places, the entire rock surface was

washed with a cement grouting and used as a floor.

The reservoir is circular, of reinforced concrete, ring tension type, 156 feet inside diameter and designed for a depth of fourteen feet of water. It is covered with a five-inch reinforced concrete roof slab carried by 10 x 15-inch beams spaced twelve feet centers each way and supported by 10 x 10-inch concrete columns. The roof was divided by expansion joints into slabs twenty-four feet square and rests freely upon the beams. The slab was designed for 90 pounds live load in excess of the dead load. The entire roof was given a slope of eight inches from the center to the outside walls.

A trench was excavated in the rock to provide a sub-footing under the walls and to secure a good bond to prevent leakage. In order to provide for the indeterminate cantilever stresses, the sub-footing was finished off smooth and an asphalt expansion joint was provided between the sub-footing and the wall footing proper.

The wall was made fourteen inches thick without taper toward top, in order to facilitate the use of slip forms. The horizontal steel was placed in two rows and held in place by vertical standards, six feet centers, built up of 3-inch channels, to which short strap-steel lugs, with notches for holding the bars, were riveted at the required intervals. The channel standards facilitated the placing of the steel and insured the proper spacing and prevented the displacing of the bars during the pouring of the concrete. The standards were accurately centered and held in place by braces until the footing had been poured and then the standards were sufficiently rigid to be self-supporting.

A system of slip forms four feet high and in sections twelve feet long were made up of 1-inch shiplap and assembled and centered in place. The forms were filled within six inches of the top and were then raised by means of the ordinary slip form jack operating on a one-inch jack rod. The jack rods were spaced approximately eight feet centers and two men made the circuit twice an hour raising the form about one inch each time. The one-inch jack rods were cut off at the top of the wall when the pouring of concrete had been completed.

The wall concrete was run continuously, requiring a total time of eighty hours for completion. There were three eight-hour shifts, each consisting of ten laborers and a foreman mixing and placing concrete, three men placing and wiring steel, two men operating form jacks and two carpenters shifting runways and miscellaneous work. Two mixers were placed on opposite sides but owing to shortage of labor only one mixer was in operation at a time, the crew changing from one mixer to the other every hour. Concrete was conveyed from mixers to wall in wheelbarrows on board runs.

This method of construction eliminated all construction joints and gave a smooth finished surface which under water test showed practically no leakage, and only slight leakage was found through the small fissures in the rock bottom. Column footings were placed and their tops carefully graded from center to walls to conform to roof slope, so that all the column forms were of same length, simplifying the construction and placing of forms. A part of the roof was poured during freezing temperatures, the work being protected by using a canvas tent covering and heating with steam coils, heating sand and water for mixing, and covering the completed work with paper and straw before removing the tent to the next section.

The location of the reservoir being on public park property, the top slab was given a float and trowel finish, and the manhole openings and ventilators were so placed that two tennis courts could be laid out on top of the reservoir. Pipe couplings or sockets were set in the roof slab for installing net posts and also around the wall for fencing the entire area.

The principal quantities in the construction were 7,162 cubic yards of earth excavation; 1,038 cubic yards of concrete; 71.7 tons of reinforcing steel and 4.2 tons of channels and miscellaneous.

The total cost of the completed reservoir was $52,887.21. The reservoir was designed by Burns & McDonnell Engineering Company, of Kansas City, and constructed by Ray & Son, contractors, of Baxter Springs, Kan.—and the work was inspected and supervised by Charles W. Lusk, city engineer of Arkansas City.

The Effect of Alkali Upon Concrete*

By S. H. McCrory†

Decomposition caused and explanations of it offered. • No method known of preventing such deterioration, but impermeability retards it. Recommendations as to aggregate, proportioning and placing of concrete.

The attention of engineers has been drawn recently to a number of cases in which concrete structures have partially or totally failed, due to the action of alkali upon the concrete. The extent and severity of this action has caused considerable concern among engineers intrusted with the design or construction of concrete structures in regions where the soils and ground waters are alkaline. Such conditions generally are found in the arid and semi-arid regions of the United States. Recently, however, a number of failures of concrete drain tile exposed to the action of alkaline soils and ground waters have occurred in the southwestern part of Minnesota. The mean annual rainfall in this region varies from 25 to 30 inches per annum and yet strong concentrations of alkalies are found.

*From "Public Roads," the official organ of the Bureau of Public Roads.

†Chief of Drainage Investigations, Bureau of Public Roads.

The alkalis present in the soils are the salts of various metals. The more common are sodium chloride (NaCl), sodium sulphate (Na_2SO_4), magnesium sulphate ($MgSO_4$), calcium sulphate ($CaSO_4$), calcium carbonate ($CaCO_3$), and calcium bicarbonate ($CaHCO_3$). Other salts are also frequently present. Typical analyses of alkalis from the surface of the ground in various locations are shown in Table No. 1, which is taken from Technological Paper No. 95, Bureau of Standards.

Table No. 1—**Typical analyses of alkalis from various localities.**

Location.	Composition of soluble solids in per cent. Na.	K.	Ca.	Mg.	Cl.	SO_4
Garland, Wyo.	30.8	0.5	0.6	0.1	Trace.	68.0
Fort Shaw, Mont.	26.2	.2	2.3	1.1	1.1	69.1
Sunnyside, Wash.	23.9	2	.6	.6	10.0	64.7
Yuma, Ariz.	24.7	.5	7.1	....	52.6	15.1
Roswell, N. Mex.	10.8	2.3	16 8	4.9	22.0	43.2
Montrose, Colo.	9.4	...	2.1	26.7	Trace.	61.8
Grand Junction, Colo	28.1	...	.7	6 5	17 1	47.5
Huntington, Utah	27.6	.6	2.4	2.5	.1	66.8

In Table No. 2 are presented a number of analyses of drain and soil water from various locations:

In both tables the SO_4 content is high for all localities except Yuma and Roswell. The alkali at Roswell, though low in SO_4, nevertheless causes serious injury to concrete that is exposed to it. It will be noted in these tables that usually some one of the constituents will predominate in a given section. Along the seacoast the predominating salt is usually sodium chloride (NaCl) or common salt, while in the Great Plains regions the sulphate type predominates.

Table No. 2—**Analyses of drain and soil water from various localities**

Location.	Per cent soluble solids in water.	Percentage reacting values. Na.	Ca.	Mg.	Cl.	SO_4	CO_3	NO_3	HCO_3
Garland, Wyo.	0.33	32.0	10.3	7.7	3.2	40.6	6.2	...	...
Fort Shaw, Mont.	.2)	30.6	6.6	12.8	1.6	34.2	14.2	...	...
Sunnyside, Wash.	.40	24.7	14.0	11.3	6.1	38.1	5.8	...	...
Yuma, Ariz.	.11	23.5	16.3	10.2	15.4	12.9	21.7	...	...
Roswell, N. Mex.	.46	23.9	19.4	6.7	27.1	23.0	2.9	...	...
Montrose, Colo.	.50	9.2	15.8	25.0	.5	46.0	3.5	...	...
Grand Junction, Colo.	.85	25.9	10.1	14.0	17.7	28.7	1.9	1.7	...
Huntington, Utah	.30	13.3	20.1	11.6	1.8	43.8	7.4	...	...
Lyon County, Minn.	.28	3.5	22.2	24.3	.3	47.5	.2	...	1.9
Lyon County, Minn[1]	3.06	25.9	8.6	15.5	T	49.5	.1	T	.4

[1]Soil water

THE ACTION OF THE ALKALI

When concrete is exposed to the action of solutions of these salts the lime of the cement combines with the salts to form other compounds. The chemical action is accompanied by a change

CONSTRUCTION DETAILS OF ARKANSAS CITY RESERVOIR

Shows method of supporting reinforcing bars and of raising slip forms. Concrete mixer in background. Wheelbarrow runway inside of forms.

in the physical condition of the concrete. The first indication of the action of the alkali that can be noted is the presence of minute crystals of various salts in the concrete. These can be detected if fresh fractures are examined. As the action progresses a chalky band forms in the concrete near the surface which is in contact with the soil. In drain tile this band usually forms at first about three-eighths of an inch beneath the outer surface. As the action progresses the band widens and assumes a white chalky appearance, much like lime mortar. As this chalky band widens, swelling and cracking of the concrete become apparent. In one case of a 24-inch concrete tile which had been placed in an 11-foot cut and exposed for about four years to the action of soil water containing 2.22 per cent of alkali, of which 49 per cent was SO_4, the swelling and cracking were very noticeable.

Most concrete structures are alternately dry and wet. The alternate drying and wetting has a tendency to impair the concrete. When salts are present this deterioration is intensified, due to their crystallizing in the concrete when it dries. In most localities there is added to this action the disrupting effect caused by alternate freezing and thawing of the moisture in the concrete. While the effect of each of these factors on the concrete may be relatively very small, they combine to make the concrete more porous and thus to admit more readily the salt-bearing solutions to intimate contact with the cementing material. Some experimentors have thought that the disintegration of concrete was caused by the formation of substances having a large molecular volume and that this occurs when the sulphate salts of magnesium and sodium are present. The chemical reactions which take place are not fully understood, but it seems that failure is due to chemical rather than physical action.

A number of samples of concrete that have been subjected to the action of strong solutions of sulphates have been examined, and in each case it is found that a considerable amount of the cement has been removed. Microscopic examinations indicate that the cementing material has been replaced by other compounds of little cementing value, such as gypsum and the carbonates of lime and magnesia.

NO PROOF AGAINST ALKALI FOUND

Many investigators have tried to find a method of making concrete that would be proof against the action of salts, but so far none has been successful. It has been shown, however, that the more impermeable the concrete, the more strongly resistant it is to the action of the salts. The strength of concrete does not seem to have a definite relation to the action of salts upon it as frequently, in testing concrete tile, specimens are found in which the concrete is seriously disintegrated but which shows little loss of strength when tested. In general, it may be said that all available data indicate that in sulphate waters the extent and rapidity of failure depend upon the concentration of the salts in the soil and soil water to which the concrete is exposed. Concentrations may occur which will cause the disintegration of the most impermeable concrete that can be made by methods now employed. Various experiments and investigations indicate, however, that when exposed to solutions of equal strength the richest mix will prove most resistant. Concretes with high absorption are especially susceptible to attack.

TO SECURE MOST IMPERMEABLE CONCRETE

If it is known that concrete is to be exposed to the action of alkalis, great care should be used in grading the materials so as to secure the densest and most impermeable concrete possible. If a choice is possible, the sand and coarse aggregate should be of such a character that they will not be affected by the action of the salts. Limestones, dolomites and sandstones should be avoided. In placing the concrete great care should be exercised to secure the best possible workmanship. The concrete, after being placed in the forms, should be well spaded and tamped, and extra precautions should be taken to prevent the formation of a porous layer at the close of each day's work. The foundation should, if possible, be thoroughly drained either by open ditches or underdrains. If this cannot be done, it might be helpful to make the backfill next to the concrete of coarse gravel, so that when the water table drops, capillary action will not bring moisture to the concrete through the soil. When it is necessary to use sand, gravel or other aggregates that are known to contain alkali salts in considerable amounts, they should be thoroughly washed before they are placed in the concrete, even if alkaline water has to be used.

Various preparations have been used in an attempt to make concrete impervious to moisture. Cement grout, tar coating, ferrous sulphate and various waterproofing paints have been tried, but so far none of these seems to have been successful. Any value they have is of a temporary character. The use of intregal waterproofing compounds or hydrated lime might be of value in securing a more impermeable concrete.

Where high concentrations of salts are known to exist, the importance of careful grading and rich mixture, so as to secure the densest and most impermeable concrete possible, cannot be overestimated. Under such conditions cement, sand, aggregate and mixing water should be the best obtainable. The fabrication of the concrete should be done by experienced workmen, and when it is placed in the forms it should be done in such manner that the structure will be truly monolithic. The foundation should be provided with the best drainage obtainable. If these precautions are followed structures can be built which will be strongly resistant to the action of alkali. There is no assurance, however, that concrete of even the highest impermeability that can be obtained under present methods of manufacture will withstand the stronger concentrations of alkali of the sulphate type.

Highway Bridge Construction—I
Unloading and Hauling Steel Girder Spans

Simple methods using ordinary plant and general contractors' equipment

Highway bridge spans up to 50 or even 75 feet in length can usually be made advantageously with plate girders, which are not only simple to fabricate, but are easily transported and can be quickly erected and put in service. Their construction is so simple that mistakes in it are minimum and the principal consideration for their installation is the selection of the most suitable method of handling the heavy concentrated weights, which may vary from 5 to 50 tons.

These bridges are always built in special shops designed, equipped and operated for bridge construction and are usually shipped to or near the bridge site by railroad on flat cars or gondola cars. Sometimes the contract provides for the erection of the spans, ready for service, by the fabricator, in which case it is only necessary for the general contractor or the engineer to provide the sub-structure ready to receive the superstructure and to take care of the traffic until the new bridge is ready to be opened.

When the highway contractors or officials erect the girders it is usually necessary to unload them from the railroad cars and transfer them to the bridge site. If the steel is delivered in a large freight yard there are usually at hand ample facilities for unloading it from the cars and reloading it on trucks by means of derricks, travelers, gantries, locomotive cranes or other power devices. If it is delivered at a country siding these facilities may be absent and the contractor or official may have to provide the entire unloading equipment.

For spans of 30 feet or less, the girders are usually laid with their webs horizontal on the floor of the car. When they are too long for the car, girders up to 35 or possibly 40 feet long are usually loaded with one end on the floor of the car and the other end raised and projecting beyond the opposite end of the car, the girder webs being vertical and braced in position. Longer girders must be loaded on two flat cars, braced together with the webs in vertical position. The braces and small pieces are loaded loose, in bundles or boxes packed on the car and easily unloaded by hand.

DERRICKS AND GANTRIES

If the contractor has a considerable amount of freight to receive at the point where the girders are delivered, it will probably pay him to install a stiff-leg derrick with a 50-foot boom of 5 or 10 tons capacity, which will suffice for handling even a 30-ton girder if necessary, by restricting the radius and by arranging to lift only one end of the girder at once, thus increasing the capacity of the derrick while reducing the load.

If derricks are not available it may sometimes be convenient to install hoisting tackle and a hand windlass or crab on a gantry or a pair of gantries spanning the track by which the girder can be lifted from the car and lowered to the track or to a truck alongside. Girders can also be handled by tackle and windlass on a gin pole or on a pair of gin poles, which are simple masts carefully placed on foot blocks, well guyed at the top and inclined so as to slightly overhang the load. These can be improvised from any suitable piece of timber and are easily erected and removed.

JACKING, CRIBBING AND SKIDDING

In the absence of all of these appliances the girders can be unloaded and reloaded by jacking and cribbing, using one or more of the most powerful jack screws available, and a sufficient quantity of short timber of any convenient dimension; railroad ties answer the purpose if nothing better is available. If the girder can be transferred directly from the railroad car to the truck by which it is to be hauled to the site, a skid, consisting of a rail or I-beam, properly supported, will be placed transverse to it at each end and supported on the railroad car and at the proper lower elevation at or adjacent to the truck or trucks. The girder should, if necessary, be jacked up sufficiently to permit the insertion of the ends of the skids under it, and to permit the withdrawal of the blocks on which it was supported, and then lowered to rest on the skids, on which it can easily be pushed transversely to a position over the trucks, or jacked up on cribbing if necessary, the skids removed and the girder jacked down to bearing on the trucks. The upper surfaces of the skids should be greased and if they are inclined much from the horizontal snubbing ropes or preventor tackle must be attached to both ends of the girder to hold it back and prevent it from slipping down the incline except as the rope is paid out.

It is possible to lift the girder with a single jack placed at each end alternately, but it is much better and much more convenient to have two jacks at each end simultaneously if possible, but successively if necessary. A short transverse beam can then be placed under the end of the girder and one jack placed at each end of it, giving greater stability to the girder. Jacks, of course, can be used in multiple by providing for suitable arrangement and balance.

ROCKING AND TURNING

If the girder is very heavy it is possible to raise or lower it slowly with the application of very moderate power by providing it with two bear-

ings only a few feet apart and on opposite sides of the center and then with jacks under each end alternately raising first one and then the other, so that the support comes on first one and then the other of the two bearings, allowing the released bearing to be raised or lowered every time.

A girder can be raised clear of the car, a suitable transverse beam or girder inserted under it at each end and supported clear of the car, the girder lowered to bearing on the beams and the car removed; after which the girder is jacked down to the ground, to low level skids or to a car or wagon placed under the beams.

When a girder is being unloaded or loaded for trucking, it is often more convenient to roll it over so that the web will be horizontal or to place it right side up, or to swing it end for end so that it will arrive at the site in the proper relative position. In rolling it over, timbers should be provided to receive it and allow it to descend gradually without slipping back. To turn it end for end it should be supported at the center of gravity on upper and lower loose steel plates with the horizontal contact surfaces well greased, which will enable the girder to be revolved 180 degrees without difficulty.

HAULING

Short girders weighing not more than 5 tons can generally be hauled on an ordinary heavy truck with a long reach, from the axles of which they may be suspended by chains at each end.

Longer and heavier girders are usually transported on special trucks, or on a truck and trailer; or by special pairs of very heavy broad-tired wheels, special axles, and bolsters on which the girder can be loaded directly or from which it can be suspended.

The girders can be hauled by from one to a dozen teams, or when very heavy, preferably by tractors. Care must be exercised in passing through very narrow or crowded streets, in turning corners and on poor roads and steep grades. Great care should be taken to avoid injuring pavements, manhole covers, and bridges, with very heavy girders, which may require to have long planks laid under the wheels or the bridges shored up before the girder passes over them.

If no other means of transportation are available, girders can be moved on rollers on very level hard road or on sectional tracks taken up in the rear and laid down in front as the girder progresses. Pieces of heavy pipe or sticks of long hard wood may be used for loose live rollers put under the front end of the girder and working out at the rear end as the girder advances; or rollers or wheels in small frames may be placed under the girder, moving along with it on a track composed of timbers, rails or I-beams laid on the surface of the ground or on crib work.

Snubbing ropes or preventor tackles must be used when the girder is going down hill, and on the level or upgrade it can be hauled by teams or tractors, assisted, if necessary, by tackles attached to the girder and to trees or dead men in advance and operated by men, teams, windlasses or by a hoisting engine installed on the girder.

Wheels or rollers can be placed under a girder, or sometimes even under a pair of girders and bracing forming a completed span, and a steam roller, borrowed from the paving equipment, can serve as a tractor to haul it at slow speed over smooth hard roads. In some cases it might be possible to use two rollers, one at each end of the girder and suspend the girder between them, thus carrying it clear of the ground.

New Bedford Water Works Notes

In its report for the year 1920 the water board of New Bedford, Mass., records that during the year a little over 5½ miles of water mains were added to the system, which is nearly twice the amount laid during the previous year. Early in the season much difficulty was encountered in obtaining labor for trench work and to remedy this the board purchased a Bucyrus steam shovel with a long dipper-handle for trench work. The shovel was received on October 11 and its use during the remainder of the year "has resulted in a saving in the cost of excavation for pipe laying, and at the same time solving the problem of the shortage of labor."

"A ¾-ton Atlas truck has been purchased and equipped with a device for operating gates in the main pipe line by power directly from the engine of the truck. This truck is held in readiness to respond to emergency calls and results in great saving of time in shutting off burst main pipes and hydrants, thus reducing the loss of water from these leaks and thereby also reducing the damage to surrounding property."

"It has always been the custom of this department since the beginning of the works, to use lead for making joints in cast iron pipe. During the past fifteen years various less expensive substitutes for lead for this purpose have been placed on the market and widely advertised in the water works field. The oldest of these is known as 'Leadite.' Some years ago a few joints were made here with two of these compounds, viz.: Leadite and Lead Hydrotite, and both appear to be giving good results here. The use of either of these substitutes results in considerable saving over the cost of lead joints.

"Some cities and water companies have been using them for several years with satisfactory results and considerable saving of labor, as well as in the cost of materials.

"Early in the season, extensive experiments were made to determine the relative value of these two compounds. As a result, Leadite was adopted, and has been used for the greater part of the work laid this year. Its use has resulted in a saving of from 70 to 80 per cent in the cost of material besides a considerable saving in the cost of labor, as the leadite does not need to be caulked after it is poured into the joint, as is necessary with lead.

"Additional saving in the cost of joints has been effected by the use of braided jute yarn in the place of ordinary loose jute for the backing of the joint."

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries .....$4.00 per year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

LARGE REINFORCED CONCRETE COVERED RESERVOIR—Illustrated 389

THE EFFECT OF ALKALI UPON CONCRETE—By S. H. McCrory—Illustrated 390

HIGHWAY BRIDGE CONSTRUCTION 393

New Bedford Water Works Notes 394

EDITORIAL NOTES 395
Form Economy for Concrete Reservoirs—Constructing Short Highway Spans—Traffic Justification for Highway Construction

Why Highway Construction Prices Are High 396

Undesirable Immigration Legislation 397

Building Construction Outlook 397

Recent Highway Prices 397

WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921—Table 398

Form Economy for Concrete Reservoirs

One of the most interesting features in connection with the concrete reservoir described in this issue is the attention given to securing maximum economy in forms. In practically all structural work of concrete the forms required add very materially to the cost, the cost of constructing, placing and removing these frequently being considerably more than that of the concrete itself. In this reservoir the engineers used slip forms for the walls, so that one set of forms 4 feet high was used for the entire height of the reservoir and as the tank was raised were moved upward gradually at very little expense. In the construction of the concrete columns, also, economy of forms was considered, in that these were arranged so that the same forms could be used throughout, although the columns themselves were of somewhat different total height to provide for an 8-inch pitch to the roof which they support. This repeated use of forms was secured by building the low footings separate from the columns and so adjusting the elevations of their tops as to bring them at a uniform distance below the roof, thus causing the remaining part of the columns to be the same height in every case.

Other notable features in this reservoir were the fact that the concrete walls were poured in one continuous operation, this insuring absolute freedom from construction joints, while the raising of the slip forms inch by inch eliminated any appearance of such joints. Also, instead of being covered with the customary groined roof, the roof of this reservoir was constructed with a reinforced concrete slab carried by reinforced beams. The top of the roof was finished off smooth and level, except for the pitch of 8 inches in 78 feet, and is used for lawn tennis courts.

Constructing Short Highway Spans

"Short Span Highway Bridges," published in PUBLIC WORKS, April 16-23, reviews the subject in a way indicating the general scope and enumerating the principal features of ordinary road bridges, which are built every year by the thousands by the cities, towns, counties and highway departments of the United States. In the aggregate they constitute much the largest proportion of highway structures and represent a corresponding amount of the total cost of building bridges other than railroad bridges. The principal considerations which should govern the location, strength, size, character and materials of the ordinary suburban or county bridge were there reviewed to show the essentials required for the final preparation of plans and the execution of the work.

It is proposed to follow this article with a series of articles describing and illustrating some of the difficulties and requirements of the construction work, enumerating most of the ordinary methods, operations, and plans that are available for this class of work under normal conditions; explaining some of the principal difficulties likely to be encountered and the methods of overcoming them; and describing processes and equipment that have been developed for this class of work. They will be illustrated, when necessary for clearness, by examples that will bring out essentials and important details of short-span bridge building, giving an intelligent idea of what is available and customary under various conditions likely to prevail, and to be helpful, whether the work is done by force account, special contractors, or under the supervision of engineers accustomed to construction work which does not involve very great difficulties, dangers or expense requiring the services of specialists. There will be descriptions of methods and plants for building piers and abutments, for storing and handling materials, mixing and conveying concrete, for the construction of concrete arch spans, slabs and girders, and for the erection of steel spans, the different articles appearing from time to time in such sequence as may be found convenient.

Traffic Justification for Highway Construction

At a meeting on April 13 of the members of the Asphalt Association, six resolutions were passed, urging the passage by Congress of a second federal aid appropriation, that highway management be divorced from politics, that the United States join the Permanent International Association of Road Congresses, that the Interstate Commerce Commission be urged to authorize reduction in freight rates on road materials, that public officials give employment to the hundreds of thousands of men now out of work by as much road construction as possible, and that "every highway be required to show traffic justification for its construction, thus guarding against extravagance and waste."

That the selection of roads in preparing the road construction program of a given state should be based upon the demands of traffic would seem to be most self-evident, and yet it is only too customary for states to give comparatively little thought to this, but rather to base the apportionment on the political importance of counties, communities or individuals who specially urge certain routes. Some states frankly announce that the counties that pay the heaviest taxes are entitled to the most money for highway improvement, while this general principle is frequently followed still further by permitting the political boss of the county to select the roads to be improved in that county.

While it is true that in a general way the counties paying the most taxes are those providing the most traffic, and the cities occupied by the most voters are those towards which the heaviest traffic is concentrated, this method of selecting routes for improvement too frequently works disastrously and most wastefu'ly, illustrations of which can be found in almost every state.

There can be no question that the only economical and logical method of apportioning improvement funds is to make a study of the traffic requirements of the entire state, regardless of county or other political boundaries, select those routes that are of first importance from a traffic standpoint, those of secondary importance, and others of less relative importance, determining the relative amounts of traffic to be anticipated for each of the routes during the next few years, and then, knowing the funds available and the amount necessary to place each of these routes in a condition capable of carrying the estimated traffic, apportion the available funds to the greatest advantage of all the traffic.

It is not now and never will be practicable to give a high-class roadway surface to every mile of road in the country, nor would such a program be financially defensible.

The solution of the problem along these lines is by no means a simple one, but requires the best judgment of those expert not only in highway construction but also in traffic determination, and must take into consideration the probable development of traffic-providing industries which may be brought about by the improvement of the highways; recognizing that under some conditions and in some localities such improvement may itself so stimulate traffic as to increase it very greatly over that which is now upon the highway in question. In other cases there may be several routes connecting two traffic centers, each about equally favored by present traffic, but the improvement of one of these may result in concentrating upon it practically all of the traffic now using the several routes.

These are only a few suggestions of the intricacy of the problem of determining traffic justification, but the difficulty should not be taken as an excuse for adopting a simpler solution, but rather should lead to the concentration upon this of the best intellects of the country. Where hundreds of millions of dollars are being spent annually on road construction, it is of the highest importance to the country at large, both as users of highways and as taxpayers, that the money so spent be placed where it will be of the greatest advantage.

Why Highway Construction Prices are High

There has been evident recently a disposition among certain officials and publications to regard as profiteering the bids for highway construction submitted by contractors that were larger than the estimates of the officials. The contractors, however, defend these as reasonable and inevitable in that they prefer to bid on facts and to base their prices on actual present costs instead of discounting a possible future fall in prices that does not promise to come rapidly and may even be preceded by a rise in the cost of some items. As one illustration, the governor of Ohio requested the highway commissioners of that state to consider reducing their estimates for all roadway projects by 20 per cent, because of his anticipation of a reduction in the cost of supplies.

An article in the "Bulletin," by Ward Christy, engineer of the Associated General Contractors, shows by figures taken from the reports of the United States Department of Labor at 14 of the largest cities, that the average increase of prices from February, 1920, to February, 1921, amounted to 18 per cent for gravel, 16 per cent for sand, and 19 per cent for cement. He also presented a very illuminating table of freight charges for the 5,166 tons of cement, sand and gravel required for the construction of one mile of standard 18-foot concrete road from 7 to 8 inches thick, made with 1:4:6 mix. Assuming these materials to be hauled by rail from the points from which they are usually shipped to ten important cities located in all parts of the United States, he shows that the present freight charge per mile of road built in different localities varies from $1,310 in Seattle, Wash., where both sand and gravel are produced and cement is only hauled from Bellingham, Wash., a distance of 119 miles, to $11,119 at Denver, Col., where sand and gravel are hauled 119 miles and cement 145 miles. For these two cities the total increases in freight charges since August, 1920, are $291 and $2,967, respectively. In Boston, where the sand is hauled 46 miles,

gravel 24 miles and cement 302 miles, the present freight charges are $7,750, showing an increase of $2,203 since August, 1920, and an increase of $4,065 since January, 1917, before the railroads went under government control.

It is further pointed out that a large road building plant may cost $100,000 and be subject to fixed charges, exclusive of operating expenses, of more than 30 per cent of the initial cost; and it follows that if the other items of fixed charges are in corresponding proportion it would require reduction of cost of variable charges, such as both labor and materials, of 30 per cent to effect a reduction of 20 per cent in the total cost of the work.

Added to this is the certainty that the big boom that is so earnestly desired in general building construction will, if it materializes in the coming season, greatly retard road construction, consequently increasing its cost.

Undesirable Immigration Legislation

The Inter-racial Council has issued a strong appeal to oppose drastic restriction of immigration at the present time. It says, in part:

"The Dillingham Bill, limiting immigration to the United States for 15 months to 3 per cent of the number of each nationality in the United States, has been killed through the exercise of the 'pocket veto' by President Wilson. This bill, which in the closing days of the session was substituted by the Senate Committee on Immigration for the Johnson Bill and was passed by both houses of Congress, was referred to the President on February 28.

"The general effects of this bill will be: To permit a very limited number of new aliens to enter the United States; to create considerable international misunderstandings because of apparent discriminations against certain nationality groups; to arouse opposition and bitterness among races now resident in the United States who have received no official recognition as a 'nationality' and who will have no definite assurance as to the number of their respective races that may enter, and to prevent the re-union of families of our alien residents.

"This bill was passed to meet an alleged emergency which, after three weeks of public hearings, the Senate Committee on Immigration showed did not exist for the following reasons: (1) Foreign nations were enacting regulations to keep their emigrants at home where they are needed, (2) steamship carrying capacity is limited to a total of 800,000 during the year, (3) Quarantine laws are sufficient to prevent the spread of disease which no percentage test can affect, and (4) existing laws are adequate if enforced."

A committee representing the Associated General Contractors has, in conference with the National Federation of Construction Industries Committee and Senator Sterling, author of the Sterling Bill, decided to oppose immigration restriction measures of an emergency nature, and to support a permanent, constructive immigration policy.

Building Construction Outlook

An investigation by the Fidelity & Deposit Company of Maryland, has disclosed that building operations are increasing everywhere in the United States except in New England and in the mountain states of Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah and Nevada. There has been an increase in productivity of labor per man since September. Building trade wages have fallen appreciably in all states except New Jersey, Illinois and in the New England states.

In general, the cancellation of orders has stopped, there is a marked resumption of industrial activity. Buying by the public is still restricted, retailers have not stocked up in expectation of good spring business nor have their prices dropped, although the cost of living is shown to have fallen appreciably since last September. The questions of taxation, railroads, peace and tariff have the greatest bearing on business prosperity, and the repeal of the excess profits tax and the substitution of a sales tax is universally desired.

Recent Highway Prices

The Wisconsin Highway Commission has recently received bids on several highway contracts, three of which were let in April.

One was for about 13,000 cubic yards of grading, concrete culverts and corrugated metal culverts on Project No. 231. The successful contractor's bid was $.53 for earth excavation, $.53 for borrow, $22 a yard for concrete culverts, $2.75 a lineal foot for corrugated metal culverts and $150 per acre for clearing and grubbing. His total bid was $10,355. Another bid was only $9 higher and there were in all six bids under $13,500 and one bid for $15,070.

On Project No. 257, 14 bids were received, ranging from $48,745 to $69,668, with 8 of the bidders not bidding on the gravel surfacing. The contract had not been awarded at our latest advice, but the itemized bids of the low bidder on the total contract was $.49 for earth excavation, $.49 for borrow, $24 for concrete culverts, $1.99 for gravel surfacing, $.75 for guard rail and $180 for clearing and grubbing.

On Project No. 193, 3 bids were received and the contract awarded to the low bidder. His total bid was $36,789 while the highest bid was $47,657. The low bidder's itemized bids were: Earth excavation $.50, rock excavation $.80, concrete culverts $24, 24-foot feather-edge gravel surfacing $2.20, guard rail $.75 a lineal foot, riprap $5 a cubic yard, borrow $.50, paved ditch $3 a cubic yard, road grader $350.

Federal Aid Project No. 233 was awarded to the lowest of five bids. The total of the lowest was $10,332 and the highest bid was $11,687—a remarkably small difference between maximum and minimum of five bids. The successful bidder's itemized bids were: Earth excavation $.45, borrow $.45, class A concrete $21, gravel surfacing $1.50, shale surfacing $1.15.

WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921 (Continued)

County and State	During 1920: Money spent for hwy. work	During 1920: Kind and amount of surface laid	During 1920: Amt. done by contract & by employees C—contract E—employees	During 1921: Money available for hwy. wk.	During 1921: Kind & amt. of surface to be laid	Amount to be done by contract and by employees C—contract; E—employees
Iowa (continued):						
Cedar	$194 627.13	mac. resurfacing	$73 814 66 E $120,812.47 C	$244,400	20 grading	all C
Cerro Gordo	705 000	15 concrete	all C	500,000	13 conc.	all C
Chickasaw	230.000	15 gravel	graveling E 14 grading C	250,000	15 grading, etc	all C
Clay	74 237 18	32 84 gravel	all C	175 000	$25.000 gravel	.....
Crawford	150.000	earth	al C	250.000	$150.000 earth rd.	all C
Dallas	253 660.74	15 gravel	all C	280 900	60 gravel	all C
Delaware	100.000	24 grading	all C	180,000	70 grading, 31 grav.	11 grading E, rest C
Des Moines	38.606	grading & draining	maint. E C	350.000	7.25 conc. pav.	al: C
Dickinson	25,000	8 gravel	8-C	125,000	5 conc. pav.	all C
Dubuque	200.000	none	50% E 50% C	275 000	.....	25% E, 75% C
Emmet	139 467 81	2 earth 9 gravel	all C	61,633.31	none	.....
Floyd	586 915.18	581,644.80 pav. or hard surface, 58 231.15 gravel	gravel E rest C	.....	5.56 hard surfacing, 15 graveling	gravel E, rest C
Greene	147 910.48	1 pav., 35.000 yds. grad.	all C	.....	5 4 conc. pav.	all C
Grundy	81.000	276 000 earth grades	all C	157,000	$65,000 earth grades	all C
Guthrie	.....	2.3 earth, 2 gravel	all E	.....	12 earth	all C
Hamilton	325.000	39 gravel	all C	150.000	10 gravel	all C
Harrison	146.000	14 earth	$82 000 C	300,000	20 earth	all C
Iowa	49,643.18	none	$29,682.53 E $19 960.65 C	185,000	183,000 cu. yds. earth	$183,000 C
Johnson	186.800	none	all E	350,000	3½ con pav., 20 earth	all C
Kossuth	350 000	3 grad., repairs	all C	400 000	100 grad., 40 graving.	a l C
Linn	229,454.52	1¾ conc. pav.	89 450 42 E 150 004.10 C	300,000	4¾ conc. pav.	a l C
Lucas	170,000	no surfacing	¼ E ¾ C	150,000	10 bdg. to perm.grade	all C
Lyon	109.000	$45 000 br. & culv., 26,000 gravel, 31,000 earth, 9 000 maint.	maint. E rest C	165.000	$63 000 perm. grade, 35,000 br. & culvts, 12,000 maint.	maint. E, rest C
Madison	32.389.87	.....	all E	200 000	11,355 grad. & brdgng.	a l C
Mahaska	45,000	none	day labor	200,000	$170,000 grad. &drnge.	$20,000 E 150,000 C
Marshall	150 000	13½ earth	$150,000 C	189 000	5.93 conc.	a l C
Monona	173.655 23	none	.....	288.000	32 perm. grading	a l C
Monroe	80,000	dirt	a l C	100,000	100,000 cu. yds. earth	a l C
Montgomery	424 000	none	.....	50,000	none	90% E, 10% C
Muscatine	154,551.94	none	.....	95,000	50½ perm. grading	a l C
O'Brien	300,170.71	$48 038 conc., rest earth	all C	1 000 000	22½ conc. pav.	a l C
Palo Alto	272.000	24 grade 11 grav., 20 til.	all C	240,000	9 conc., 14 gravel, 4 grading	all C
Pocahontas	288 643.78	19 earth 12½ gravel	all C	350,000	27 gravel, 14 earth, 24 road tiling	all C
Sac	233 000	40 gravel	culverts & bridges E roadwork C	235 000	40 gravel	a l C
Scott	658 988.53	3 mac., 2 brick pav., 8 base for brick pav.	all C	1 700 000	25 pav., $100.000 conc bridges, 35 grading	.....
Tama	112.000	none	.....	240 000	30 grading & drnge.	maint. E, rest C
Union	80,000	none	all E	200 000	$160.000	$75,000 E, $5,000 C
Van Buren	120 000	10 prim. & grad.	½ E ½ C	130.000	16 primary & grading	½ bridges E grading C
Wapello	216,675.66	$74,000 grade, $70,000 rd wk., $70 000 bridge	all C	200 000	18 perm. grade	a l C
Warren	104,572 80	none	none	350.000	200 000 cu. yds. grading 9 700 lin ft. tile	a l C
Webster	418 8[illegible]	9 gravel	all C	280,000	21.5 gravel, 9 gravel surfacing	a l C
Winneshiek	73 000	none	none	300,000	perm. grade & drnge.	$20,000 E, $280.000 C
Woo[illegible]	49 115	gravel	all E	160,000	8½ gravel	a l C
Kansas:						
Allen	235 154.19	.92 conc., 3 mac., 4¾ grade	conc. C rest E	.....	2 conc., completion of mac.	2 C
Anderson	235,000	7¼ gravel, 125 earth	$60.000 E $175 000 C	100 000	9 gravel, 180 grading	all E
Atchison	300,000	9 concrete	all E	300.000	conc.	all E
Barber	144,000	dirt	$100.000 E 44 000 C	125 000	grading	100,000 E, 30.000 C
Barton	125 572.91	dirt, conc.	all E, exc. twp.	70.000	150 grading	a l C
Brown	124 265	none	$50.000 E 74,265 C	100 000	no hard surfacing	½ E, ½ C
Cherokee	90,575.73	$37,409 67 chat., $13 862 73 earth	all E	500.000	3 conc., 13¼ chat. br.	a l C
Crawford	169 000	10 chat	all E	155.000	30 grading & bridges 4 conc. or brick	a l C
Elk	27,000	3 gravel, 2 mac.	all E	27,000	same as 1920	3 gravel, 1 mac. E 1 mac. C
Finney	76,000	1¼ conc., 60 earth	60 E ¼ C	1 250 000	100 grading, 27 conc.	earth E, conc. C
Geary	247 000	4¾ concrete	all C	219 000	4¼ conc.	a l C
Graham	10,000	earth	grad. C, rest E	20 000	grading & maint.	all E
Greeley	5,000	.....	all E	8 000	earth	all E
Harper	90 000	maintenance	all E	100 000	.....	all E
Johnson	100 000	[illegible] mac.	2 mac. E, rest C	140 000	90 dirt, 6 mac	a l C
Kingman	128,000	17 dirt, 216 maint.	all E	82,000	gen. repr. & maint.	all E
Labette	275 000	20 gravel	20 C	150 000	24 gravel	a l C
Lyon	120,000	60 000 conc., 60 000 earth	½ E ½ C	230.000	100 000 conc., 130,000 earth	30,000 E 200,000 C
Marion	50,000	dirt	.....	50 000	grading	all E
McPherson	463 820	.....	all [illegible]	18 000	dirt	all E
Meade	60,000	5.3 earth, 100 regraded	grading [illegible] 5 3 C	25.000	earth	all E
Mitchell	144 039.13	1½ concrete	bridges & culv [illegible] conc C	550.000	10 conc., 60 earth	earth E, conc. C
Montgomery	275.000	10 gravel	3 E, 7 C	300 000	14 gravel	11 E, 3 C

WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921 (Continued)

County and State	During 1920: Money spent for hwy. work	During 1920: Kind and amount of surface laid	During 1920: Amt. done by contract & by employees C—contract E—employees	During 1921: Money available for hwy. wk.	During 1921: Kind & amt. of surface to be laid	During 1921: Amount to be done by contract and by employees C—contract; E—employees
Kansas (continued):						
Nemaha	$200,000	earth	25,000 E 175,000 C	$120,000	earth	.....
Norton	40,000	none	20,000 E 20,000 C	60,000	maint.	road work E bridge work C
Osage	48,000	perm. grading	all E	57,000	same as 1920	all E
Pawnee	27,000	2 gravel, 80 earth	all E	99,500	5 gravel, 90 earth	all E
Russell	20,000	dirt	8,000 E 12,000 C	15,000	dirt	7,000 E, 8,000 C
Sedgwick	523,125.78	brick, conc., sand clay & earth	354,839.90 C	350,000	3¾ conc., 9½ brick	150,000 E 200,000 C
Shawnee	200,000	10 conc., 5 gravel	gravel E conc. C	300,000	40 grading & culvrts.	all C
Smith	21,656.96	.....	all E	.....	.....	all E
Stafford	20,000	gravel on dirt rds.	all E	.....	gen. upkeep	all E
Wabaunsee	50,000	none	....	50,000	$20,000 dirt	all E
Kentucky:						
Allen	52,500	5 earth, 3 gravel	all E	26,000	earth, gravel	all E
Barren	.....	.....	....	100,000	26 rock asphalt	all C
Bracken	50,000	15 mac.	all C	115,000	17 mac.	all C
Daviess	150,000	river gravel	$115,000 E 35,000 C	150,000	10 river gravel	all C
Fleming	26,000	maintenance	....	16,000	3 resurfacing, 1 mac.	all C
Gallatin	10,000	limestone	6 E	Indef.	8 limestone & gravel	all C
Hopkins	60,000	23 grading & draining	all C	500,000	17 gravel, 12 fed. wk.	all C
Mason	50,000	none	....	.....	repair & maint.	all E
Montgomery	45,000	10 000 mac.	all E	25,000	.....	co. money E, Fed. C
Morgan	35,000	earth grade	all E	150,000	grading	all C
Oldham	30,000	mac., gravel	16,000 E 14,000 C	.....	.....	.....
Owen	52,000	12 mac.	all E	35,000	5 mac.	.....
Pike	30,000	.....	....	.....	25 mi., 26 in. bit. mac.	all C
Rockcastle	92,000	3 grad. & mac., 3 grading	3 grad. & mac. E 3 grad. C	200,000	5 grading & mac., 2 grading, bridge	5 grading & mac., 1 grading E, 1 grading, bridge C
Shelby	104,000	maintenance	all E	100,000	23 bit., 300 mac. mnt.	maint. E, 23 C
Whitley	244,800	23 graded road	52,800 E 192,000 C	.....	10 Ky. asphalt	all C
Louisiana:						
Avoyelles	300,000	60 graded, conc. drainage structures	all C	1,500,000	75-100 graded conc., drainage structure	all C
Caldwell	200,000	13.7 fed. aid.,70 Parish rds.	all C	200,000	16.6 fed. aid, 13.7grav.	all C
Maine:						
Knox	50,000	gravel	all C	.....	gravel & dirt	all C
Maryland:						
Kent	134,000	2 conc., 1.5 mac.	all C	78,000	5 conc.	all C
Massachusetts:						
Athol	42,000	1½ gravel	....	50,000	2,300 sq. yd. conc. gravel	.....
Essex	507 043 83	2 bit. mac., cem., conc.	all C	181,700	bit. mac. gravel	all C
Milton	.....	2,508 war.-bit.	....	.....	.....	.....
Michigan:						
Alger	127,000	4 mac.	all E	125,000	5 mac., 4 earth, 3 asp. pen.	5 mac. E, rest C
Cass	250,000	gravel & conc.	1 mi. C, rest E	200,000	2 conc., 50 gravel, 2 bit. mac.	90% E, 10% C
Dickinson	117,035.76	3 grav., 2 bit. mac.	1.02 bit. mac. E 4 C	290,000	6.5 gravel, ½ bit. mac., 4.8 grading	bit. mac. & grad. E, gravel C
Eaton	204,000	28 gravel	5 E, 23 C	250,000	60 gravel	5 E, 55 C
Emmet	90,000	21 bit. mac., 5 gravel	all E	100,000	20 gravel	30% E, 70% C
Grand Traverse	54,398.15	gravel	2-3 E, 1-3 C	60,000	gravel, stone, conc.	½ E, ½ C
Kalkaska	27,564.23	none	all E	60,000	gravel	all C
Lapeer	150,000	gravel	all C	Indef.	25 gravel	all C
Luce	66,000	3¾ gravel	all E	75,000	4 mac.	all E
Macomb	1,000,000	3 conc., 12½ gravel	all C	500,000	10 conc., 14 gravel	all C
Mason	85,985.84	6 gravel	all E	125,000	11 gravel	6 E, rest C
Missaukee	40,500	5 gravel	2 E, 3 C	135,000	14 gravel	3 E, 11 C
St. Joseph	15,000	110,000 gravel 40,000 conc.	gravel E conc. C	400,000	.....	50,000 E, 350,000 C
Minnesota:						
Aitkin	58,400	gravel	14 E, 16 C	175,000	20 gravel	10 E, 10 C
Big Stone	207,500	21 gravel, 27 top soil	all C	192,000	27 gravel, 15 topsoil	all C
Blue Earth	217,147.76	gravel maint.	all C	250,000	20 grading, 25 gravel	gravel E, grad., C
Brown	160,000	grading, graveling & bridges	100,000 E 60,000 C	140,000	graveling, bridge	graveling E, br. C
Carlton	159,979.87	19 gravel, 14½ earth	12 gravel, 4½ earth, E, 7 gravel, 4½ earth C	99,000	10 gravel, 10 earth	10 gravel, 5 earth E, 5 earth C
Carver	95,000	12 gravel	all C	40,000	3	all C
Chippewa	350,000	gravel	10% E 90% C	100,000	.....	50% E, 50% C
Chisago	600,000	37 gravel, 23 gravel with rock top	all C	250,000	5½ conc., 10 gravel	all C
Cottonwood	240,000	30 gravel	all C	120,000	14 grade, 10 gravel	all E
Dakota	.....	43,594 war.-bit.	....	.....	.....	.....
Dodge	234,362.06	10 grading, 8½ grav.	all C	409,521.57	18½ grad., 17 grav.	all C
Faribault	196 334.35	21 gravel	6.5 E, 14.5 C	308,855	27.3 perm. grade, 21 gravel	10 grav. E, rest C
Goodhue	393,662.93	3.5 conc., 40 gravel	37 gravel E rest C	170,000	7 grading, 25 gravel	gravel E, grad. C
Grant	100,000	10 earth, 12 gravel	9 gravel E rest C	60,000	5 earth, 10 gravel	gravel E, earth C
Hennepin	.....	94,583 war.-bit.	....	.....	.....	.....
Hubbard	30,000	1.5 gravel	all C	280,000	48.42 gravel	all C
Isanti	129,463.28	9½ grading, 13.75 gravel	5½ gravel C rest E	Indef.	.....	all E

(To Be Continued)

NEWS OF THE SOCIETIES

May 2—MILWAUKEE CHAPTER, AMERICAN ASSOCIATION OF ENGINEERS. Milwaukee, Wis.

May 3—CLEVELAND SECTION, AMERICAN SOCIETY OF MECHANICAL ENIGNEERS. Engineering Societies Rooms.

May 9—HARTFORD BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Get-together dinner at City Club.

May 9-11—AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo.

May 9-11—NATIONAL CONFERENCE ON CITY PLANNING. Pittsburgh, Pa.

May 9-12—SOUTHWEST WATER WORK ASSOCIATION, Shirwin Hotel Headquarters, Oklahoma City, Okla.

May 10-12—CANADIAN GOOD ROADS ASSOCIATION. 8th annual convention. Halifax, Can. Secretary George A. McNamee, Montreal.

May 16-18—AMBASSADORS & MINISTERS OF WORLD TRADE. Conference under auspices of NATIONAL ASSOCIATION OF MANUFACTURERS. New York City.

May 17—CLEVELAND SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual dinner.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne, Ind.

May 18—BIRMINGHAM SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual business meeting. Southern Club.

May 19—EASTERN NEW YORK SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Edison Club Hall, Schenectady.

May 19—SAN FRANCISCO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

May 20—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, 370th meeting. Engineering Societies Building, New York City.

May 20—PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual dinner, Hotel Adelphia Roof.

May 21—ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with ATLANTA SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

May 21—CENTRAL PENNSYLVANIA SECTION. Spring meeting. State College with headquarters at University Club.

May 25-6—NATIONAL INDUSTRIAL TRAFFIC LEAGUE. Cleveland, O

May 23-26—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting. Congress Hotel, Chicago.

May 31-June 3—NATIONAL ELECTRIC LIGHT ASSOCIATION. Pasadena, Cal.

June 15-17—LEAGUE OF MICHIGAN MUNICIPALITIES. Annual Convention. Kalamazoo, Mich.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-8—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

BROOKLYN ENGINEERS' CLUB

At the meeting of April 21, "Government Control of Professions with Particular Reference to Proposed Legislation for Regulating the Practice of the Engineering Profession" was discussed by William P. Bannister, secretary of the State Board of Examination and Registration of Architects, a member of the Joint Committee of the National Council of Engineers and Architects, and a member of the Constitutional Convention of 1915.

April 28, "Handling Bulk Material in Large Quantities" was described by A. B. Proal, Jr., engineer with Robins Conveying Belt Company, and illustrated by moving pictures of the world's largest lime stone plant, the operation of a self-unloading boat and automatic coal handling machinery at B. & O. station.

AMERICAN SOCIETY OF CIVIL ENGINEERS

May 4 Ernest E. Howard presented a paper on "Vertical Lift Bridges," discussing the historical development of the lift bridge, the general elements of design, and a detailed description of three types—the lifting span, the lifting deck and the combination lifting span and lifting deck.

A complete series of lantern slides illustrating various types and details was shown, including views of the Columbia River Interstate bridge, the North Kansas City bridge and the Harriman bridge at Portland, Ore.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The 1921 spring meeting of the American Society of Mechanical Engineers is to be held in Chicago May 23-26, at the Congress Hotel.

Well developed programs will be presented by the professional divisions of the society devoted to Forest Products, Fuels, Machine Shop Management, Material Handling, Power, Railroad, and a specially important session will be devoted to Training for Industries. The Chicago committee, jointly with the Western Society of Engineers, is preparing a session on "Chicago as the Rail-Water Gateway."

The application of material handling machinery to road building has been adopted by the materials handling division for its spring meeting program. The highway needs of the country are great and the province of the mechanical engineer in satisfying these needs is well defined. Instead of excursions, a number of moving pictures will be shown in which the uses of road building machinery will be displayed to those attending the meeting.

The program of papers includes: "Planning and Organization of a Road Job for the Mechanical Handling of Material," C. D. Curtis; "Road Plant Operations, with Practical Analysis of Operating Road Plants," B. H. Piepmeier; "What the Contractor Needs," Gen. R. C. Marshall, Jr.

Visits to a great number of points of engineering interest in Chicago will be arranged. Special attention is being given to the corelation of plant visits with the technical sessions.

En route to the meeting, the society, jointly with the Society of Automotive Engineers, will stop at McCook Field on Saturday, May 21, for an inspection of the facilities of the field.

On May 27-28, the Friday and Saturday following the meeting, a joint excursion with the Army Ordnance Association will proceed to Rock Island Arsenal, where the Ordnance Division will present papers and enjoy an inspection of the plant. Saturday will be devoted to a handicap golf tournament on the Rock Island links.

THE ASPHALT ASSOCIATION

The second annual convention of the Asphalt Association, held at the association headquarters in New York, April 13, marked important general advances in the road building and street paving field. President Draney predicted that, unless reactionary pessimism grips the nation, 700,000 men will be needed in the building of the 35,000 miles of new highways contemplated this year under the billion dollar road program outlined by the Federal government and the states and counties. Three hundred thousand more men, he said, will be needed in the quarries, gravel pits, cement, brick and asphalt plants and factories devoted to the manufacture of road machinery. The road building boom, he thought, will work great benefit to the railroads by bringing into service one hundred thousand idle freight cars to transport one hundred million tons of road materials.

The association adopted resolutions as follows:

1. Urging Congress to pass the Federal aid appropriation of $100,000,000, thus assuring a continuance of road building under the supervision of skilled state and Federal engineers.

2. Urging that highway management be divorced from politics and all materials and methods entering into highway construction be placed in open competition.

3. Declaring that every highway be required to show traffic justification for its construction, thus guarding against waste and extravagance.

4. Memorializing Congress to authorize the United States to join the Permanent International Association of Road Congresses made up the highway departments of all nations.

5. Urging the Interstate Commerce Commission to authorize a reduction in freight rates for road materials, thus stimulating the road building program.

6. Recommending that public officials carry forward road building programs to the extent permitted by appropriations available, thus giving employment to many hundred thousand men now out of work and utilizing tens of thousands of idle open top freight cars.

The new directors elected were: Henry Fisher, Herbert Spencer, J. R. Draney, F. A. Hogan, J. S. Helm, E. J. Morrison, F. P. Allen, L. M. Law, H. B. Pullar, G. H. Perkins, W. T. Headley, J. E. Clark, Richard Pebworth, B. F. Richardson and Michael White.

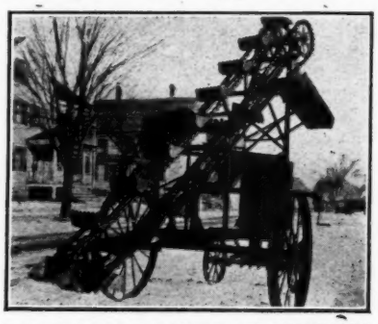
The directors elected F. P. Allen as vice-president and re-elected J. E. Pennybacker secretary.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

HIGHWAY CONSTRUCTION EQUIPMENT

A circular issued by the Conant Machine Co. illustrates and describes 7½ h. p. collapsible loading machine and 5 h. p. loading machine, both mounted on trucks and useful for handling coal, sand, crushed stone and other loose and heavy materials, especially for road building purposes. They may be fitted with gravel screening apparatus and used with or without connections to the elevating and screening plant and storage bins made by the same company that also supplies the electric motors, gasoline engines, wheels, elevator buckets and chains and are manufactors of tractors, trailers, steam rollers, stone crushers and dump wagons.



SWIVELING LOADER TRAVERSED BY HAND WINDLASS

They especially recommend a swiveling loader of the same dimensions as the collapsible machine, with the lower end of the bucket elevator traversed 6 feet laterally, by a hand windlass, enabling the elevator to clear its own path with little shoveling.

STROUD ROAD MAKING MACHINERY

Catalog No. 21 of Stroud & Co., illustrates elevated graders, wheel scrapers, drag scrapers, little red wagons, blade scrapers, dump carts, highway maintainers, Fresno scrapers, truck bodies, road plows, drags for scrapers and bulldozers.

The elevator graders, made in two sizes to be hauled by teams or tractors, are designed to move more dirt per horsepower and at less expense than any other grader. For use with the graders there are offered little red dump wagons of 1½-yard capacity and big red dump wagons of 3 to 5 yards capacity, adapted for large loads on long hauls. These wagons are provided with a ratchet dump, a trailing guide and are constructed so as to be turned around within their own length.

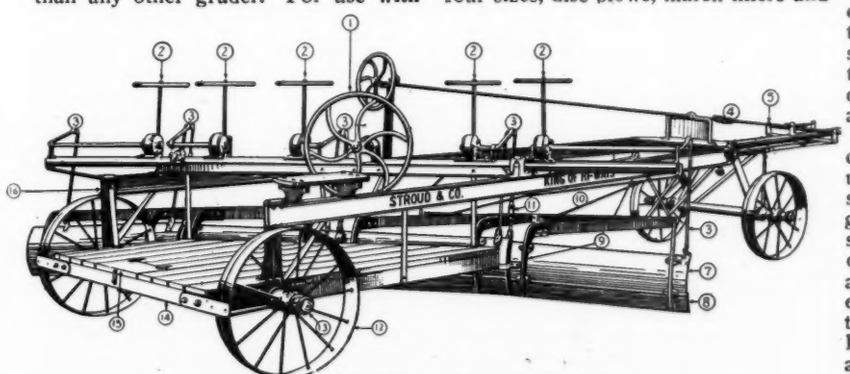
1800-POUND LITTLE RED DUMP WAGON SERVING ELEVATING GRADER MACHINE

The "King of Highways" road maintainer has four blades held firmly to the ground by eight pushrods giving them positive action and they are all lifted by a master worm gear that enables them to be rapidly elevated 40 inches or quickly lowered to working position. Each blade is controlled by a smaller worm gear enabling it to be set as desired, thus conforming to a horizontal or curved cross section and assuring accurate crowning.

The reversible road machines are made with blades up to 12 feet long that are firmly held in position by screws. The pull on the blade is direct to the tongue, putting no strain on the frame, while the rear axles take care of the side draft so that the machine is always in line with the work.

The adjustable road drag has two 7 or 8-foot blades for use in spring in maintaining good roads while the earth is soft.

There is a large line of bowl drag scrapers, butt scrapers, tongue scrapers and wheel scrapers, grading plows of four sizes, disc plows, marsh fillers and other road building and maintaining equipment.



KING OF HI-WAYS ROAD MAINTAINER

AUSTIN MOTOR SWEEPER

This is claimed to be the latest and most sanitary street cleaning machine on the market. It sprinkles, sweeps, collects and transports to the dump quickly, silently and economically.

The specially designed chassis conforms to model A of the United States Government truck specifications and the engine develops 41 h. p. It is specially constructed to endure severe conditions and hard service.

The large water tank and spraying equipment in the front of the machine wets the dirt before sweeping and eliminates dust.

The rear or pick-up broom, 36 inches in diameter and 7 feet long, has low and high speeds for regular service and for especially dirty streets, respectively. The conveyor, water spray, pump and gutter broom are operated at the same speed simultaneously. The rear broom contains 175 pounds of bamboo fiber 12 inches long, retained in alignment by automatically adjustible end disks, with spindles running in oil-tight boxes. The broom is enclosed in a steel housing and is suspended from springs regulating the pressure on the pavement.

The gutter cleaning broom, 42 inches in diameter, projects 5 inches outside the rear wheels and is inclined so as to enable the gutter dirt to be thrown in the path of the pick-up broom. It has steel fibers 12 inches long held in position by aluminum castings. It is chain driven with self-aligning ball bearings and is operated by a special clutch.

The elevator is of unique design especially intended to eliminate difficulties usual with elevating graders. It has a series of heavy steel and rubber squegees continuously moving upward on a steel plane that pick up the dirt that is continuously delivered to the elevator and carries it into the hopper, handling earth, stone, slush, broken bottles and the like without difficulty. The elevator hangs higher than other types, giving an increased clearance, and is absolutely dependable.

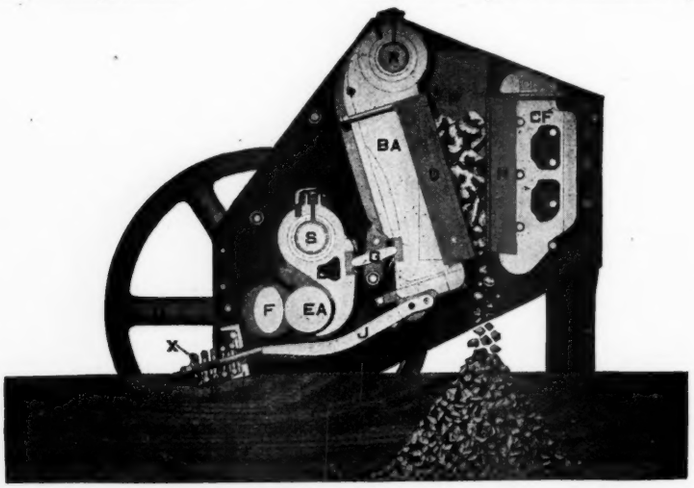
MAY 1 C 1921

The steel hopper of more than 2 yards capacity is dumped through bottom doors operated from the driver's seat. The hopper is designed to be filled at about the same time that the water tank is emptied, so that both can be emptied and filled simultaneously. All shafts have self-aligning bearings and automatic lubrication. Machines have already been installed in Chicago, in Akron, Ohio, in Rochester and other cities.

CHAMPION MACHINERY

Champion crushing, elevating, screening and conveying machinery, catalog published by the Good Roads Machinery Company, illustrates and describes the principal details and general features of the steel rock crusher mounted on a steel frame truck with folding type of wood frame elevator. The No. 4½ machine has a 10 x 20-inch opening and a large capacity and is built for heavy usage.

Telescopic storage bins of 15, 20, 30 and 40-ton capacities are fitted with revolving cylinder screens and loading gates, and are mounted on wheels for easy transportation.



SECTIONAL VIEW OF ROCK CRUSHER

Both buckets and belt conveyors are listed, as are portable engines and boilers of 13 sizes of 4 to 50 h. p. The belt conveyor can be equipped with a discharge carrier that will work automatically back and forth to discharge material evenly along a given space, or set to discharge material at any given point on the line of the conveyor.

The Good Roads catalog describes six sizes of Winner graders, the smallest for use with two horses, and the largest, with a 12-foot blade to be hauled by a tractor. The Killifer scarifier has five massive adjustable teeth and can be drawn by a tractor or steam roller. There are two and three-blade road drags, and there is a road hone mounted on wheels for smoothing, leveling and surfacing dirt roads. There are Monarch road rollers, oiling and heating machinery, street sweepers and sprinklers, steer sweepers and portable engines and boilrs. There are also corrugated metal and interlocking cast iron culvert pipes.

HERCULES AJAX—ON HIGHWAY CONSTRUCTION

Building highways with pre-cast concrete blocks by the Hercules Ajax-On road building method is claimed to secure an indestructible highway of great strength at one-third less than the usual cost and at a minimum maintenance charge.

The pre-cast concrete blocks 6 inches thick are claimed to have a compressive strength three times as great as ordinary concrete and to weigh 160 pounds per cubic foot against 110 pounds for average concrete. They may be continuously manufactured by a small force operating a plant that will provide 100 miles of road surface and that costs no more than the plant required for building 5 miles of ordinary highway.

The blocks are made of cheap local materials shipped to the site by truck or trailer and put in position by the Ajax-On road paving appliance that is provided with a grading plow in front, with block handling apparatus and with horizontal jacks pushing the apapratus forward.

With advantageous weather conditions the units can lay 700 linear feet of finished roadway in one 8-hour shift daily from April 1 to December 1, thus producing 20 miles of 18-foot roadway in one season.

THE AMERICAN GASOLINE LOCOMOTIVE

The American gasoline locomotive, built by the Hadfield-Penfield Steel Company, is designed for industrial activities where a gasoline locomotive is adaptable and is simple, reliable, efficient, easily operated and as nearly fool-proof as possible. It has a friction drive, a Hercules motor, efficient cooling cistern, telescopic couplings, with self-aligning axle and drive chain operation.

It has a very strong, rigid, cast-iron frame, a 4-cylinder, 4-cycle Hercules motor developing 23 h. p. at 1,000 r. p. m., and is built in standard sizes of 4 to 7 tons, and larger sizes to special specifications. The low sizes are especially fitted for tunnel service. The 4-ton machine has a length of 122 inches, height of 72 inches and a width varying from 24 inches to 56 inches, according to gauge. Its speed is up to 12 miles per hour with a draw-bar pull at normal engine speed of 1,600 pounds.

INDUSTRIAL NOTES

The building construction and industrial portions of the Lakewood Engineering Company's line will henceforth be handled by William H. Hale, of William H. Hale & Co., well known equipment dealers of Minneapolis. At the same time the sale of Lakewood paving equipment will be conducted by C. D. Smith, formerly associated with Mr. Hale, at the Lakewood Engineering Company office in Minneapolis.

Vickers-Petters, Ltd., has opened new offices and show rooms at 75B, Queen Victoria street, London, E. C. 4, England, for the exhibition of various types of Petter oil engines and VickersPetter semi-deisel crude oil engines. Branch offices have also been opened in Glasgow, Bristol and Dublin.

The Brier Hill Steel Co., Youngstown, Ohio, has opened its Pittsburgh district sales offices, with Robert C. Barton, district manager of sales, in charge.

The Carmean Electric Company has been incorporated with headquarters at Kansas City, Mo.

The Gardner Machine Co., of Beloit, Wis., has put H. J. Gaumond, formerly with the Federal Machinery Sales Co., in charge of the Chicago district.

GEORGE A. JOHNSON COMPANY

Announcement is made of the reorganization of Johnson & Benham, Inc., under the new name of George A. Johnson Company, the members of which are George A. Johnson, Nelson B. Wolfe, Harold C. Stevens and Charles R. Wychoff.

The George A. Johnson Company engages in the professional practice of civil, electrical and mechanical engineering.

PRICE REDUCTION

In keeping with the general trend of prices, Yoemans Brothers Company, of Chicago, pioneer manufacturers of sewage ejectors and pumping machinery, have made a decided reduction in the prices of their products, which include the Shone pneumatic sewage ejector, electrically operated centrifugal sewage ejectors, automatic electric bilge pumps, condensation return pumps and horizontal centrifugal pumps for all purposes.

WATERPROOFING CONCRETE

The Truscon Laboratories, Detroit, will send free on application a copy of the new technical pamphlet No. 8, containing: A discussion of why concrete requires waterproofing and the properties an integral waterproofing must possess to operate effectively with the natural properties of concrete. Specifications for waterproofing mass concrete by integral method. Specifications for waterproofing concrete and general masonry structures by means of waterproofed plaster coat. Proportions and quantities of waterproofing required.

DEARBORN TRUCKS

Worm drive, 1½ and 2-ton trucks, are illustrated in catalog of the Dearborn Truck Co., who produce 1½ and 2-ton complete trucks, and the best form truck with which any automobile car can be converted into an economical 2-ton truck.